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# Heavy Metal Pollution from the Particles in the River Bottom Sediments in Urban

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**Abstract - Distributions of arsenic and other heavy metals in river bottom sediments were investigated in the Ina River flowing in the eastern part of Hyogo Prefecture. Concentration of arsenic at the Ina River is higher than the permissible level. The cause of soil and water contaminations by arsenic is thought to be geologic origin such as old mine. The Ina River has also recorded heavy metal-bearing river bottom sediments.**

## I Introduction

Ina River is large size river that runs down mountain and urban areas including a part of the Hanshin Industrial district. The Ina River has recorded heavy metal-bearing river bottom sediments (Nabeshima and Tainosho, 2000). The cupper deposits in this area are generally small in scale with the exception of the Tada mine, which produced about 5,000 tons until 1970, when it was closed.

Arsenic concentration in the Ina River is higher than the permissible level (0.05mg/l) based on the measurements of arsenic concentration in this river. One of the most damaging effects of the arsenic has been ground-water contaminations. Attention should be paid to river bottom sediments in the Ina River.

Shoge River is small size river that runs down the midst of urban area. Recently environmental pollution caused by factories has been increasing rapidly. The river bottom sediments collected from the Shoge River have high heavy metal concentrations.

The purpose of this article are to describe heavy metal pollution from the old mine and industrial waste to formulate some principles for waste.

## II Materials and methods

The river bottom sediments were collected from the Ina River to study the heavy metal pollution. River bottom sediments are composed of fragmented matter consisted of smaller particles than boulder. These samples were sieved through 100 mesh to remove gravel sized materials (Adati and Tainosho, 2001), because clay mineral is a mineral with a complex crystal structure that really absorbs other ions. The collected samples were dried for few hours at a temperature of 105°C for analyzing.

Chemical compositions of the river bottom sediments were analyzed by energy dispersive X-Ray fluorescence (JEOL, JSX-3220). Analytical conditions were as follows; 30KV of the tube voltage, 500 seconds of live times and fundamental parameters algorithm for fixed quantity. The boric acid was mixed with the river sediments at the ratio of 3.00g (boric acid):2.00g (sample). Selective samples were analyzed to find the heavy metal particle by using field emission scanning electron microscope (FESEM, JEOL JSM-6330F) linked with ED-XRF (EDS, Oxford Link ISIS). The electron microprobe analysis (JEOL 8900) is also useful for identification of heavy metal pollution sources.

## III Results

Arsenic showed the highest concentration at the old mine (Tada mine) monitoring point located in upper reaches, among the sampling points in the main stream, and several small river bottom sediments also contain high arsenic. The result shows samples from many sample sites having more than 0.05 mg/l in arsenic concentration. The concentration of arsenic was found to be influenced from near the old mine in the Ina River.

Other heavy metal concentrations in the river bottom sediments are also higher than other river bottom sediments in Hyogo Prefecture. Zinc and cupper concentrations range from approximately 0.1 wt% and are considerably higher than are average value of about 0.01 wt% in the other river bottom sediments.

Arsenopyrite derived from the old mine were found as major arsenic component in most of the river bottom sediments in main stream by using field emission scanning microscope (Figs. 1, 2).

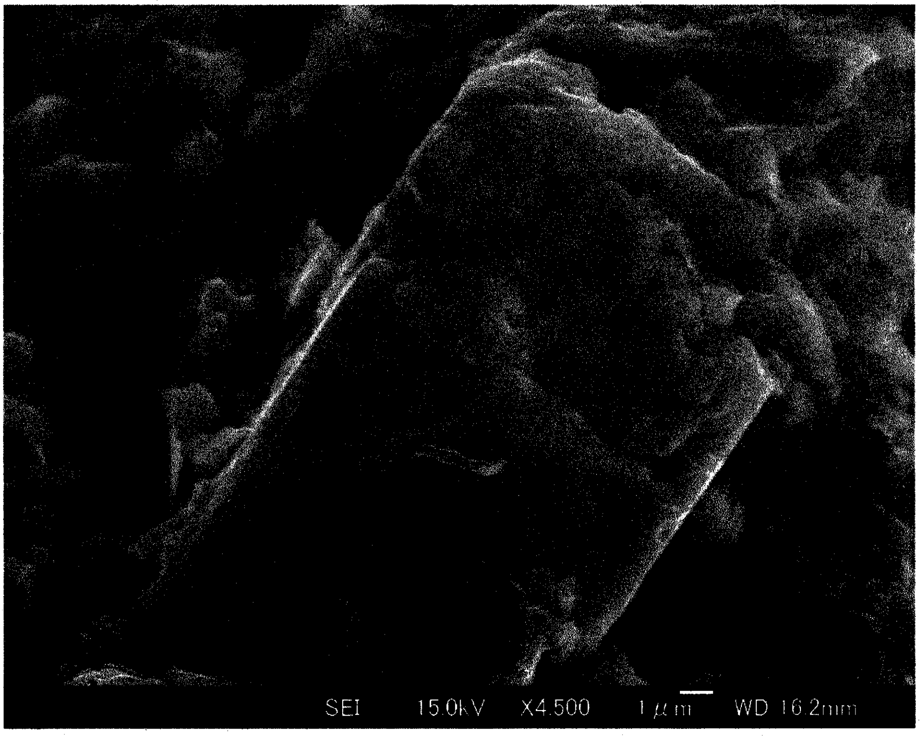


Fig.1 FE-SEM image showing arsenopyrite particle included by bornite.

Fig 2 FE-SEM image of the bornite with tiny arsenopyrite (white color).

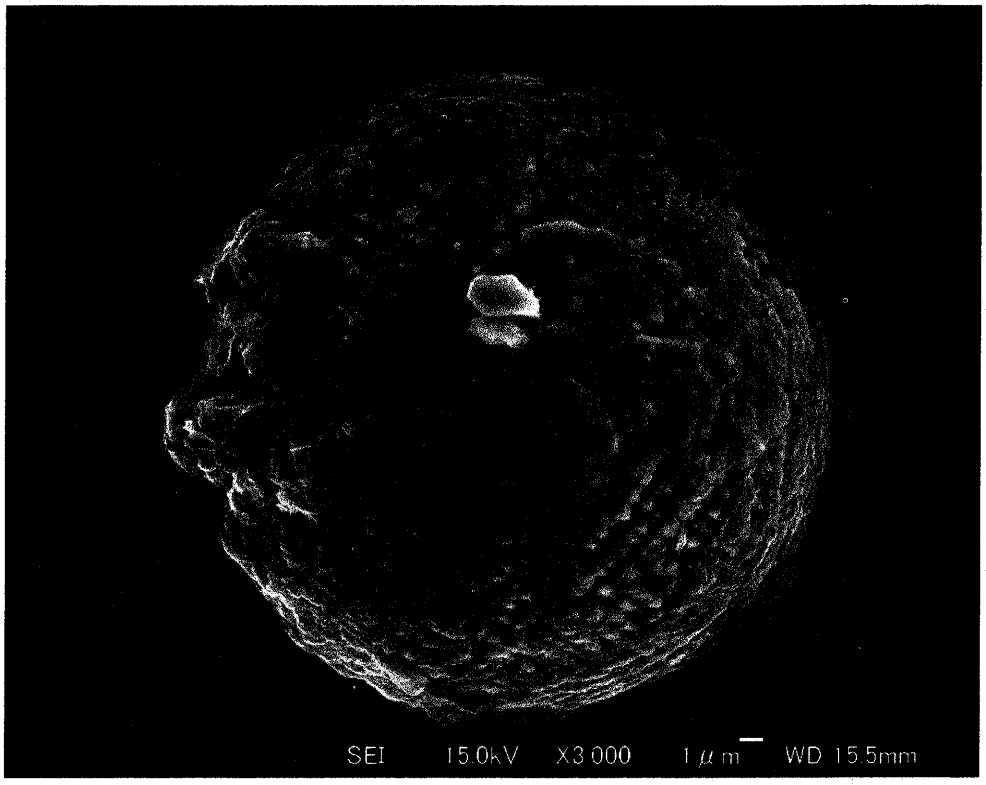


Fig. 3 FE-SEM image of the spherical iron.

Fig. 4 FE-SEM image of the spherical sulfur-bearing iron.

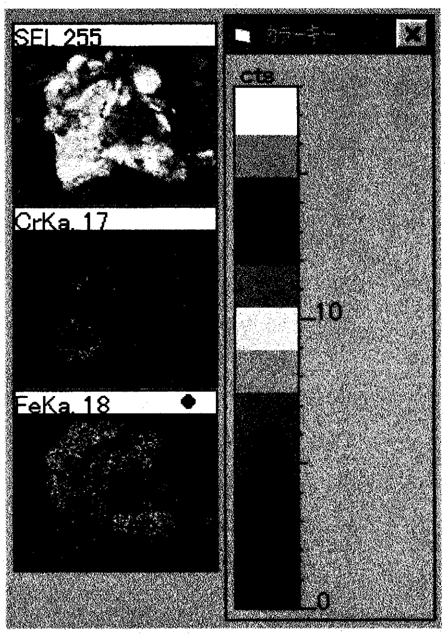


Fig. 5 Compositional map of chrome-bearing iron steel in the river bottom sediments.

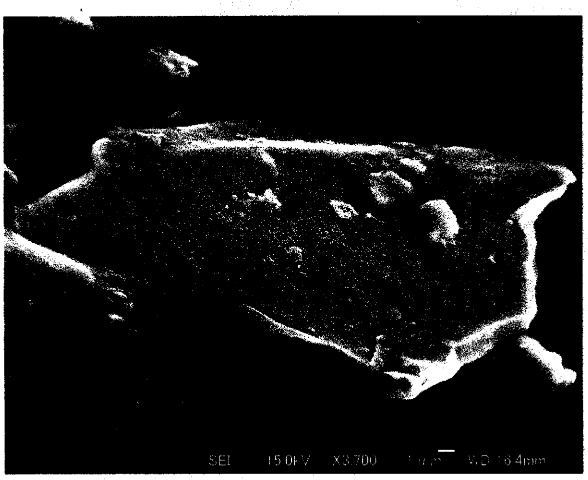

Fig. 6 FE-SEM image of zinc-bearing cupper steel.

The river bottom sediments from the Shoge River are rich in Fe, Cu, Zn, Pb, Mn, Cr, Ni and Ba (Nabeshima and Tainosho, 2000). Among these elements, the sediments from the Shoge River mainly contain iron, zinc and cupper with little lead. Zinc concentrations range from approximately 0.1 to 0.05 wt% and are considerably higher than average value of about 0.01 wt% in the other river bottom sediments.

Selective samples were analyzed to find the heavy metal particle by using field emission scanning electron microscope. Spherical iron particles were found in the river bottom sediments (Figs. 3, 4). Shafts, tiny chips and scraped particles of brass are also found in the river bottom sediments near the industrial area (Figs. 5, 6).

## IV Discussions

Much river water in the Ina River has more than 0.05 mg/l in arsenic concentration (Ashida *et al.*, 2001).
The arsenic problem may be occurring in the Ina River. The cause of groundwater and soil contaminations by arsenic is believed to be geologic origin concerning for mine deposits. However, the arsenic contamination was almost unknown in the Ina River (Ashida *et al.*, 2001). Based on the measurements of arsenic concentration in all river sediments near the old mine (Tada mine), arsenic concentrations are higher than the permissible level. Reason for the high arsenic concentration is due to the some mine deposits such as bornite with tiny arsenopyrite judging from field emission scanning microscope measurements. Arsenopyrite included by
bornite is main sources for arsenic based on electron microscope images (Figs. 1, 2).

Analysis of the river bottom sediments were carried out at the center of the highly heavy metal contaminated area of the Ina River. These river bottom sediments are particularly rich in Fe, Cu, Zn, Cr and Ni.

Many heavy metal particles were found by using field emission scanning electron microscope. Among them, spherical iron particles were found in highly contaminated sites. Some brass particles found in the river bottom sediments of the industrial area have characteristics shapes such as artificial shapes (Fig. 6). These materials including steel and other alloyed metals are derived from the industrial operation work (Adati and Tainosho, 2001), based on these scanning microscope images.

From these results and long-term monitoring data of the heavy metal elements including arsenic in the river sediments, it is presumed that the distributions of heavy metal elements in the river sediments are influenced basically by geological features, and by an industrial complex causing serious environmental hazards.

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